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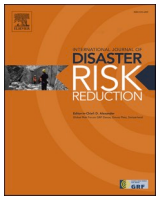

Preparedness for mass gatherings: Planning elements identified through the Delphi process

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ABSTRACT

Background: Mass gatherings create a need for careful pre-planning and preparedness due to their impact on authorities' resources and potential delays in response for emergencies. The aim of this study was to investigate all aspects of preparedness for mass gatherings from a multi-sector expert board's point of view.
Method: Delphi-process was carried out involving experts from rescue service, emergency medical services, event organizers and on-site medical care providers. The Delphi questionnaire for Round 1 was based on previous research. The criterion for consensus was set at minimum 80% agreement in any of the three categories: important, neutral, and not important. Mean values were calculated using a five-point Likert scale. New claims were constructed from the results of open-ended questions.
Results: The expert board found consensus in 50 out of 55 claims. Consensus percentages ranged from 100% to 53% and the mean values from 4.96 to 3.29 after the final, Round 3. Based on the results, authorities need to prepare for mass gatherings with additional operative resources. However, the focus of their preparedness should be outside of the event area itself. Regarding on-site medical care, in the largest and high-risk mass gatherings medical care should be provided by professionals rather than by volunteer based service.
Conclusion: The multi-sector expert board found consensus on the majority of claims regarding preparedness for mass gatherings. The results of this study can be utilized in harmonization of practices and operative resources planning. Predicting authorities' workload requires further research in order to enable more accurate resource deployment.

1. Introduction

Characteristics of mass gatherings, from the preparedness point of view, include a risk for delays in possible emergency situations, which may be caused by environment and location, or demarcated access to patients [1]. A risk of mass casualty incident is also constantly shadowing mass gatherings, for example in forms of violent sabotage and human stampedes [1–6]. Moreover, a risk of infectious diseases exists in mass gatherings in particular when people travel to mass gatherings from different countries and continents [7,8]. Fire safety issues, limited access to venue, poor emergency response, medical preparedness, crowd control and overcrowding have caused many catastrophic accidents in the past [3]. In a similar way, environmental hazards and extreme weather conditions have caused fatalities in many cases [9]. Based on the special characteristics represented above, mass gatherings create a need for preparedness and planning in order to secure adequate response for potential emergency situations and support attempts to prevent potential accidents. Preparedness for mass gatherings involve various factors to be considered at different phases of the event. Besides the event organizer, preparedness for mass gatherings involve multiple authorities and stakeholders [6].

According to a recent study, mass gatherings increase the workload of rescue authorities in the pre-planning phase, especially considering the emergency plan processing [6]. However, workload for them during the event itself is minor, compared to the workload demanded from the police and emergency medical services (EMS) [10]. For the police force, mass gatherings may strain administrative resources in the pre-planning phase, considering consultations of event safety and administrative

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processing of the necessary licenses required for the event. In addition, police forces' operative resources are encumbered during the event in various ways [6,10–12]. Mass gatherings may also strain health care resources and impact especially EMS and hospitals' emergency departments [6,10,13,14]. Environmental factors influencing health care workload, as identified in the previous literature, are weather conditions [9,15–20], the level of on-site medical care, such as presence of physician led medical teams [16,21–27], the type of event, such as percentage of seating and bounding of venues [28–30], and the location, such as austere environments, and the duration of the event [31,32]. In addition, population related factors impacting resources include e.g., an expectation how the participants will behave in the event [33], their substance use [27,31] and age, as well as crowd mood [31].

In sum, mass gatherings require planning and preparedness at many phases, involving collaboration of representatives from multiple sectors. This study investigates preparedness for mass gatherings from the point of view of experts representing rescue service, EMS, event organizers, and on-site medical care providers. The study expands the evidence base of the subject and provides a wider perspective of the phenomenon.

2. Materials and methods

This study was carried out by using the Delphi technique, which allows a diverse group of experts to seek consensus on a specific subject, by processing the research subject remotely and anonymously. In this study, an expert board, representing multiple sectors sought consensus on factors to be considered in preparedness for mass gatherings.

Research permits for this study were requested from 40 Finnish organizations including rescue departments, police administration, hospital districts, event organizers and on-site medical care providers. 24 organizations, representing rescue service, hospital districts, on-site medical care providers and large event organizers agreed to participate. Mass gathering experts from the organizations were identified and eventually 28 volunteer experts were invited in Round 1, out of which 25 participated in this study. The demographic characteristics of the expert panel members are presented in Table 1.

2.1. Preparation phase and round 1

Round 1 was based on the study by Koski et al., 2020 [6], where factors to be considered in preparedness for mass gathering according to the rescue authorities were investigated. The design of the first Delphi round followed the framework of the analysis of that study. The questionnaire for Round 1 was arranged thematically following the main themes and sub-themes presented in that study [6].

For Round 1, the questionnaire was designed to investigate the importance and the order of the specific factors regarding preparedness for mass gatherings. 37 claims were formed and grouped under three main themes that included 12 sub-themes, following up the analysis and the results of a previous study [6]. The response options (Table 2) were presented using a five-point Likert-scale, and were the following: 1 = "not at all important", 2 = "not important", 3 = "neutral", 4 = "important", and 5 = "very important". There was also an option 6 to select "no expertise to answer" as some of the claims were sector-specific. An open-ended question text box was included at the end of each of the three main themes, in which the participant had an opportunity to comment from their own point of view, if there was something missing from the questionnaire regarding preparedness for mass gatherings.

Before Round 1, the questionnaire was piloted by 14 experienced advance level paramedics, who were completing their Master's degree in South-Eastern Finland University of Applied Sciences, in order to reveal possible problems in phrasing the claims and assuring the technical adequacy of the software. The students assessed if the claims were understandable or needed further editing. Three claims, which had consensus <75% considering understandability, were revised based on the feedback.

The questionnaire was sent in April 2020 to 28 experts out of which 25 responded (response rate 89%) during the three weeks of given response time. During this period, two reminders were sent. In the analysis phase, the scales were trichotomized as suggested in previous studies [34–36]. The three categories were: 4–5 "important", 3 "neutral" and 1–2 "not important", excluding "no expertise to answer" options. Consensus was determined as ≥ 80% of answers in any of these three categories. In addition, the mean values were calculated from the initial results to describe the prioritization of the factors the expert board considered as important. The results are presented in Table 2.

The content of the open-ended questions in the text boxes was analyzed using inductive content analysis process described by Elo & Kyngäs 2008 [37]. All new information that emerged from the open text boxes regarding the research topic was included as claims in Round 2. New claims were mainly categorized under the original sub-themes. However, as all new content did not fit under the original sub-themes, new sub-themes were additionally formed. The new claims and sub-themes are presented in Table 3.

2.2. Round 2

A new questionnaire was provided for Round 2. The second round included the same three main themes as Round 1. Nine sub-themes were left from Round 1, and in addition, as new content emerged from open-ended questions in Round 1, three new sub-themes were also formed. The second round included in total 12 sub-themes. In total the second round had three claims which did not reach consensus in Round 1, and 18 new claims that emerged from the experts. Round 2 did not contain further open-ended questions.

The analysis regarding Round 1 was provided for the informants in the cover letter; and the dispersion of answers was displayed in the next questionnaire for those claims that did not reach consensus in Round 1.

The response rate for Round 2 was 96% (n = 24). The analysis of Round 2 was conducted using similar methods as Round 1. The results of the analysis are presented in Table 3.

2.3. Round 3

The final questionnaire included ten claims under six sub-themes and three main themes that had not yet reached consensus in the previous rounds. Open-ended questions were not included in Round 3.

Round 2 analysis was provided for the informants similarly as in the prior round and they were asked to answer the questionnaire again. The analysis of Round 3 was carried out in similar way as in previous rounds. The response rate for Round 3 was 92% (n = 22). The results of the Round 3 analysis are presented in Table 4.

Table 1
Demographic characteristics of the expert panel members (N = 25).

Characteristic		N (percentage)
Gender	Male	19 (76%)
	Female	6 (24%)
Age	25–39	4 (16%)
	40–49	13 (52%)
	50+	8 (32%)
Sector	Rescue service	11 (44%)
	Emergency Medical Services	7 (28%)
	Event organizer/on-site medical care provider	7 (28%)
Work experience in mass gatherings	<5 years	2 (8%)
	5–10 years	5 (20%)
	>10 years	18 (72%)

Table 2
Round 1 results.

Main theme/sub-theme/Claim	Important (%)	Neutral (%)	Not important (%)	Mean value	Level of consensus (%)
Main theme 1. Co-operation in the pre-planning phase					
Sub-theme: Multi-authority co-operation during the planning stage					
Rescue service, police and EMS work in close collaboration during the pre-planning phase.	100	0	0	4.84	100
Stakeholders, such as traffic and environmental authorities, are consulted in the pre-planning phase	88	12	0	4.24	88
Considering the event arrangements, the organizer's competence in risk identification is assured and actualization of the emergency plan is verified on-site.	100	0	0	4.76	100
Authorities prepare in non-organized mass gatherings by increasing operative resources (e.g. end of school term, national celebrations).	92	8	0	4.38	92
Sub-theme: Provided authority support for planning work					
Pre-event briefing is organized involving the essential participants.	96	4	0	4.52	96
Authorities provide guidance and advice for the event organizer.	100	0	0	4.72	100
Event organizer and authorities practice together actions in accident situation beforehand.	56	36	8	3.76	56
Sub-theme: Event organizer's awareness of their duties and responsibilities					
Event organizer understands their responsibility considering the overall safety.	100	0	0	4.96	100
Event organizer has a duty to co-operate with authorities.	100	0	0	4.72	100
Event staff's skills need to be verified and event organizer provides additional training if needed.	100	0	0	4.48	100
Sub-theme: Cycle of continuous learning and development					
Past years statistics and data from mass gatherings are utilized in planning of additional operative resources as a part of preparedness.	92	8	0	4.33	92
National experiences are mapped via colleagues and lessons are learned from accidents occurred in international mass gatherings	100	0	0	4.46	100
Feedback session, involving essential participants, is organized after the event.	87	13	0	4.14	87
Main theme 2. Factors to be noted in mass gathering event's emergency plan					
Sub-theme: Event characteristics and the profile of the participants					
Mass gatherings have a high-quality security.	100	0	0	4.80	100
The skill levels and the amount of on-site medical personnel need to match the event type and the participation rate.	100	0	0	4.79	100
Ancillary services, such as commercial, parking, accommodation and water supply, are specified through risks and directions in the emergency plan.	88	8	4	4.16	88
Sub-theme: Taking into account the special characteristics of the extrinsic environment					
Vicinity of CBRN (chemical, biological, radioactive, nuclear)-sites is noted in the emergency plan, by defining range in site and event organizer's ability to evacuate the area.	96	4	0	4.52	96
Watercourse related risks are noted in the preparedness plan, by providing additional requirements for the event organizer and notifying the emergency department collaboration with search and rescue stakeholders.	96	4	0	4.75	96
Authorities' response delays to the site are noted in event organizer's self-preparedness (events in austere environments e.g. archipelago and cross country)	100	0	0	4.84	100
Sub-theme: Safety of the venue infrastructure					
Equipment and electrical safety, deployment of flammable gas, and pyrotechnical arrangements with appropriate permits are included in the emergency plan.	100	0	0	4.52	100
Durability and sizing of structures and actions when the wind limit is exceeded is included in the emergency plan.	100	0	0	4.48	100
Sizing of premises is notified by describing how the venue is applied in the specific event and how space in square meters is correlated with the participation rate.	96	4	0	4.48	96
Sub-theme: Preparedness for exceptional circumstances and sudden weather changes					
Technology related risks are noted in the preparedness plan by brining additional telecommunication access points on-site in case of a network crash.	92	8	0	4.42	92
Preparedness for exceptional weather is noted in readiness to increase authorities' operative resources and by describing event organizer's preparedness for suspending the event in case of dangerous weather conditions.	96	4	0	4.52	96
Planning of event security needs to include preparedness for violent sabotage (terrorism/strike by disturbed person)	100	0	0	4.54	100
Sub-theme: Crowd movement and control					
In crowd movement and control, entering and exiting from the area is executed smoothly, and boundary conditions are determined through exit capacity.	100	0	0	4.79	100
Fence deployment inside the area in order to control crowd movement is pre-planned and include use of pressure fences to prevent crowd crushing and how fences are opened if crowd is fleeing in panic from the area.	100	0	0	4.83	100
Exit arrangements are done in awareness of sufficient exit width based in the maximum assumed participation rate and exit ways are deployed in many directions.	100	0	0	4.80	100
Sub-theme: Securing authorities' accessibility inside the venue					
Map of the event area is delivered beforehand for the authority use.	100	0	0	4.92	100
Authority access for the area is secured by providing rescue roads from many directions.	100	0	0	4.88	100
Main theme 3. Actions during the event					
Sub-theme: Maintaining the situational picture					
Information flow between the event organizer and authorities is secured during the event by daily situational updates, involving participation of the essential people.	80	20	0	4.20	80
Special situation room is established in mass gatherings, where rescue service, police, EMS and event security operational leadership are present.	72	16	12	3.92	72
Event safety organization is required to execute self-surveillance during the event in addition to the pre checking before the event, carried out by the rescue authority.	96	4	0	4.44	96
Sub-theme: Maintaining the level of service					
	83	17	0	4.04	83

(*continued on next page*)

Table 2 (*continued*)

Main theme/sub-theme/Claim	Important (%)	Neutral (%)	Not important (%)	Mean value	Level of consensus (%)
In order to secure the level of service, stakeholder collaboration is done during the event by notifying volunteer fire service use impact on authorities' operative actions, and by increasing authorities' resources if needed.					
Mass gatherings impact on off venue locations is acknowledged in authorities' operative actions.	96	4	0	4.65	96
Workload caused by mass gatherings outside the venue is acknowledged in planning of authorities' operative resources.	96	4	0	4.33	96
Authorities' operative resources are deployed in the event area upfront.	64	20	16	3.80	64

2.4. Ethical considerations

The research permits were obtained from all organizations participating in this study, participation was voluntary, and all informants provided informed consent. As per Finnish regulations, ethics committee approval is not needed for this type of study; however, the University of Helsinki ethical principles for human subjects were followed [38].

3. Results

3.1. Round 1

In Round 1, consensus was reached in 34 out of 37 claims (Table 2). The three claims that did not reach consensus were imported to Round 2 for the second assessment. Mean values in Round 1 ranged from 4.96 to 3.76. The highest mean value (4.96) was identified for the item "event organizer understands their responsibility considering the overall safety". The mean values of the three claims that did not reach consensus ranged from 3.92 to 3.76. Open-ended questions after main themes resulted in total 23 individual text comments. The length of the comments varied from a single sentence to over 400 words deliberation. The content represented the points of view from all sectors involved in the study. These resulted in 18 new claims under three new sub-themes for the second round (Ensuring the flow of information, Sufficient first aid capability and Command chain during the event).

3.2. Round 2

In Round 2 consensus was reached in 11 out of 21 claims leaving 10 claims for further assessment in Round 3. Mean values in Round 2 ranged from 4.63 to 2.87. The highest mean value (4.63), was identified for providing information regarding mass gathering events to the Emergency Response Center. Mean values of the ten claims that did not reach consensus ranged from 4.00 to 2.87.

3.3. Round 3

Round 3 was executed including ten remaining claims, which had not reached consensus in previous rounds. Further 5 of 10 claims reached consensus in Round 3. Mean values in Round 3 ranged from 4.41 to 3.29. The highest mean value (4.41), was identified for the claim that tax funded authority resources, especially EMS, should not be used for service in the event area. The responsibility of the preparedness should be on the event organizer. Claims considering the event organizer and authorities practicing together actions in an accident situation beforehand, and deployment of authorities' operative resources in the event area upfront, processed through all three rounds without reaching consensus. The mean values of the five claims that did not reach consensus ranged from 4.27 to 3.29.

4. Discussion

In this study, our aim was to investigate preparedness for mass gatherings through Delphi-process, from the point of view of experts representing rescue service, EMS, event organizers, and on-site medical care providers. Our findings showed that the majority of the factors included in the Delphi process were experienced as important to take into account. This study revealed new points of views regarding preparedness for mass gatherings.

In Round 1, thematic organizing of claims was based on the results of an earlier study [6]. The first main theme titled Co-operation in the pre-planning phase and included multi-authority collaboration during the planning, involving consultation of key stakeholders, preparing with sufficient resources in organized and non-organized mass gatherings. In addition, sub-themes included event organizers awareness of duties and responsibilities and claims considering the cycle of continuous learning and development. According to previous literature, mass gatherings require careful pre-planning as increased operative workload strains authority resources. Workload impacts especially for EMS and police operative resources can be considerable [10–13,17,39] and there can also be workload impacts for health care facilities [14,27]. Taking into account mass gathering event's impact on resources is vital in maintaining the adequate level of service during the event. The majority of the mass gathering related workload for rescue service is administrative and occurs in the pre-planning phase [6]. Results of Round 1 also included consensus in use of past years statistics in resource planning for mass gatherings. Previous literature presents different models for data utilization in mass gatherings resource planning. The phenomenon can be viewed from a predictive [30,40–43] or retrospective [13–15,17,26,29,31,32,39,44–47] perspective. Utilizing data from previous years might help the timely and geographically correct deployment of the resources in addition to resource planning. Pre-checking of the event arrangements, verification of event staff's skills, and organizer's awareness of responsibilities and actualization of the emergency plan were also included in Round 1. Previous studies show that mass gathering disasters occurred in the past have involved factors, that should be checked and included in the pre-planning phase, such as issues in fire safety, absence of on-site medical care, communication with EMS, the capacity of exit ways and the adequacy of crowd control measures [3].

The second main theme in Round 1 was factors to be noted in the emergency plan. This theme included five sub-themes, of which one was event characteristics and profile of participants' sub-theme. According to previous literature, the level of on-site medical staff impacts the use of EMS resources [16,21–23,27,48]. According to a recent study by Castro-Marin et [49], deploying on-site alcohol sobering facility significantly reduces the need for EMS transports. Moreover, event characteristics such as temperature [17,45], event type, participants' substance use, event duration, attendance, and venue characteristics correlate with the need of medical care [29]. Considering the need of security, according to a study by Zeitz et al. (2007), workload for the police resources appears especially at night time [10]. Understanding the factors that can influence the need for EMS resources can help to anticipate the possible workload during the event. The results of the Round 1 included also taking care of ancillary services such as water supply. Providing free water can reduce the need of medical attention [30]. One of the sub-themes comprehended notification of special characteristics of extrinsic environment such as events held in austere environments. Taking into account the authorities' delay in response in preparedness was also included in the results through factors to be noted in the emergency plan. A study by Bledsoe et al. [32] showed that mass

Table 3
Round 2 results.

Claim	Important (%)	Neutral (%)	Not important (%)	Mean value	Level of consensus (%)
Main theme 1. Co-operation in the pre-planning phase					
Sub-theme: Provided authority support for planning work					
Event organizer and authorities practice together actions in accident situation beforehand. (Did not reach consensus in Round 1)	66	26	9	3.65	66
Authorities are responsible for clear instructing and surveillance of mass gatherings.	100	0	0	4.50	100
Sub-theme: Multi-authority co-operation during the planning stage					
The essential authorities process the event in planning phase at first without the event organizer.	39	17	44	2.87	44
Instructions and legislation considering event-related camping should be updated, so it would be clearer which authority instructs and provides authorizations.	73	23	4	3.82	73
Sub-theme: Cycle of continuous learning and development					
Event organizers' expertise considering mass gatherings should be utilized by authorities when composing guidelines for events.	75	4	4	4.00	75
Main theme 2. Factors to be noted in the emergency plan of mass gathering event					
Sub-theme: Ensuring the flow of information					
Event organizer need to plan instructions for crowd considering prohibited actions and items and plan instructions in case of accident situation.	92	8	0	4.46	92
Information regarding mass gatherings should be forwarded to Emergency Response Center.	92	4	4	4.63	92
Functionality and reception of the authority network should be taken into account in planning process.	96	4	0	4.54	96
Sub-theme: Sufficient first aid capability					
Tax funded authority resources, especially EMS, should not be used for service in the event area. Responsibility of preparedness should lie with the event organizer.	69	17	13	3.96	69
In biggest and high risk events, the event organizer should be required to arrange on-site medical service with professional, more comprehensive service rather than use volunteer actors, and limit volunteer based action in care, such as detoxification service instead of actual on-site medical actions.	78	4	18	4.00	78
Considering on-site medical care arrangements, focus should be on quality over quantity. (Adequate professional-based on-site medical service should not be replaced by larger amount of volunteer-based lower skilled personnel.)	88	12	0	4.33	88
Sub-theme: Safety of the venue's infrastructure					
Building and dismantling of the event should be taken into account in event safety planning process.	87	13	0	4.21	87

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Table 3 (*continued*)

Claim	Important (%)	Neutral (%)	Not important (%)	Mean value	Level of consensus (%)
Sub-theme: Preparedness for exceptional circumstances and sudden weather changes					
Mass gathering planning process should include plans in case of mass casualty incident.	83	9	8	4.25	83
Sub-theme: Crowd movement and control					
Different transportation options regarding exiting the event area and alternative routes should be mapped and guided.	100	0	0	4.59	100
Sub-theme: Securing authorities' accessibility inside the venue					
Organizing rescue roads from all directions is impossible to carry out in some events, which requires special attention in event organizer's resources to be able to keep the available rescue roads open.	92	4	4	4.38	92
Main theme 3. Actions during the event					
Sub-theme: Maintaining the situational picture					
Special situation room is established in mass gatherings, where rescue service, police, EMS and event security operational leadership are present. (Did not reach consensus in Round 1)	88	8	4	4.13	88
Collaboration meetings or situation update meetings during the event are carried out only in the biggest and high risk events.	75	25	0	3.96	75
Sub-theme: Maintaining the level of service					
Authorities' operative resources are deployed in the event area upfront. (Did not reach consensus in Round 1)	69	17	13	3.83	69
The focus of authorities' preparedness should be outside of the event area.	59	33	8	3.67	59
Event's professional health care operator participates also in treatment of emergency patients.	65	17	16	3.74	65
Sub-theme: Command chain during the event					
Command chain of situations during the event should be pre-planned taking into account authorities' actual readiness to take the situation in control.	96	0	4	4.46	96

gatherings in austere environments require special focus on planning of on-site medical care. The sub-themes also included safety of the venue infrastructure and preparedness for exceptional disorders and sudden weather changes. Safety of the infrastructure in the venue included equipment and electrical safety, durability and sizing of structures and sufficiency of premises. Previous literature shows that disasters in mass gatherings have been associated with issues in electrical safety, resulting in blazes [3]. In addition, collapse of structures and stampedes caused by overcrowding have caused casualties in multiple cases [3,50]. Preparedness for exceptional weather conditions and disorders such as violent sabotage and were also included in claims. According to a review by Soomaroo and Murray [9], exceptional weather conditions have caused fatalities in mass gathering disasters of the past. Mass gatherings also create a potential risk for violent sabotage [5,12,20], and this risk is increased when high-profile targets, such as politicians participate in the event [20]. Thus, as also represented in the results of Round 2, plans for mass casualty incidents should be in considered in the planning process. Moreover, the questionnaire included sub-theme considering crowd movement and control. Previous literature have shown that issues in crowd control and obstruction of authority access to area can lead to disastrous consequences [3,50].

The third main theme, Actions during the event, included two sub-themes: Maintaining the situational picture and maintaining the level of service. Maintaining of situational picture include information flow between the organizer and the authorities during the event by containing daily situational updates and constant update of threat level. In addition, information flow between authorities through operational leadership being present in established situation room was included in this sub-theme. Issues in communication with authorities were identified as learning points in the Ramstein Air Show disaster in 1988, 2001 Volendam night club fire, and in the 2010 Love Parade disaster in Duisburg [3,50]. Considering the sub-theme about maintaining of the level of service, our results showed that the expert board agreed in claims regarding planning of additional resources for planned and un-planned mass gatherings due to increased operative workload. Previous literature support this finding [6,24,32,51]. However, in our results, the expert board agreed in Round 2, that authority resources should mainly be used outside of the venue itself, whereas the main

Table 4
Round 3 results.

Claim	Important (%)	Neutral (%)	Not important (%)	Mean value	Level of consensus (%)
Main theme 1. Co-operation in pre-planning phase					
Sub-theme: Provided authority support for planning work					
Event organizer and authorities practice together actions in accident situation beforehand. (Did not reach consensus in Rounds 1 and 2)	63	23	14	3.55	63
Sub-theme: Multi-authority co-operation during the planning					
The essential authorities process the event in planning phase at first without the event organizer (Did not reach consensus in Round 2)	53	19	29	3.29	53
Instructions and legislation considering event-related camping should be updated, so it would be clearer which authority instructs and provides authorizations. (Did not reach consensus in Round 2)	76	24	0	3.81	76
Sub-theme: Cycle of continuous learning and development					
Event organizers expertise considering mass gatherings should be utilized by authorities when composing guidelines for events. (Did not reach consensus in Round 2)	82	18	0	4.09	82
Main theme 2. Factors to be noted in the emergency plan of mass gathering event					
Sub-theme: Sufficient first aid capability					
Tax funded authority resources, especially EMS, should not be used for service in the event area. Responsibility of preparedness should lie with the event organizer. (Did not reach consensus in Round 2)	86	14	0	4.41	86
In biggest and high risk events, event organizer should be required to arrange on-site medical service with professional, more comprehensive service than volunteer actors, and limit volunteer based action in care, such as detoxification service instead of actual on site medical actions. (Did not reach consensus in Round 2)	86	9	5	4.32	86
Main theme 3. Actions during the event					
Sub-theme: Maintaining the situational picture					
Collaboration meetings or situation update meetings during the event are carried out only in the biggest and high risk events. (Did not reach consensus in Round 2)	91	9	0	4.05	91
Sub-theme: Maintaining the level of service					
Authorities' operative resources are deployed in the event area upfront. (Did not reach consensus in Rounds 1 and 2)	73	18	9	3.73	73
The focus of authorities' preparedness should be outside of the event area. (Did not reach consensus in Round 2)	82	18	0	3.91	82
Event's professional health care operator participate also in treatment of emergency patients. (Did not reach consensus in Round 2)	77	14	9	4.27	77

responsibility of on-site medical care should lie with the event organizer.

Round 2 included completely new points of views that were formed from the material derived from the open-ended question presented in Round 1. Ensuring the flow of information during the emergency plan process occurred as new sub-theme, and the experts reached consensus

considering confirmation of functionality of the authority network during the planning process. In addition, the experts agreed that the mass gatherings planning process should include informing the emergency response center beforehand. Previous studies have shown that functional communication is vital if a disaster happens [3]. Communication issues, for example, delayed deployment of police forces for crowd control aid and evacuation of the area in 2010 Duisburg Love Parade Disaster. The expert board also stated that it is important that the organizer deploys adequate resources in order to keep the rescue roads open to secure authority access to the area, especially in venues where access is limited by geography. Previous literature supports the importance of securing authority access to the area [50]. Planning of instructions by organizer considering prohibited actions and items and planning of instructions in case of accident and including plans in case of mass casualty incident were also included in the results of this study. Another new sub-theme in Round 2 was sufficient first aid capability, considering the level and deployment of medical staff. Considering on-site medical care arrangements of the event, the focus should be on quality over quantity. This means that adequate professional-based on-site medical service should not be replaced by larger amount of volunteer-based lower skilled personnel. In addition, the expert board agreed that on-site medical care in the biggest and high risk events should be organized by professionals rather on a volunteer-basis. Previous studies indicate that the use of professionals reduces the need of ambulance transports and the workload of local health care facilities [14,21–23]. In our results, expert board found consensus that it is important to pre-plan command chain in order to gain actual readiness to take the situation in control by authorities if needed. For example during the Duisburg disaster, triage procedures were used to prioritize treatment for casualties [50]. Previous literature indicates that decision makers may be exposed to flood of events, because collecting information is time consuming and the quality of information in crisis situation is often incomplete and ambiguous, which makes the situation assessment difficult [50]. Poor co-ordination between the organizer and authorities has been shown to be a learning point in past mass gathering disasters [3].

4.1. Strengths and limitations

Using 80% consensus instead of a more common 75% criterion [52] enhances reliability of this study, as informant groups were not equally sized. With an 80% rate, none of the informant groups could dominate the results. Despite the challenges caused by the Covid-19 outbreak and the informants therefore being very busy during the time of the data collection, the response rates of all questionnaire rounds were good (89% from original participants, 96% of Round 1 participants and 92% of Round 2 participants). These response rates show a high level of commitment of the expert board leaving drop-out rate low. The vast majority of the informants participated in this study also in the final round. The expert board members represented a variety of sectors whose work is associated with mass gatherings; this variety further strengthens this study. The Delphi technique characteristics enable avoiding the risk of any individual expert dominating the process [53]. This is important, as the Finnish expert community in this field is relatively small and people know each other personally. A five-point Likert scale was chosen, because it gives reasonable sensitivity for the study and less than five-point scale has been indicated to perform poorly regarding reliability, discriminating power, and validity. In addition, reliability decreases with more than 10 response options [54].

Our aim was to recruit informants also from police forces, as preparedness for mass gatherings involve that sector. A research permit was applied from the Finnish police administration. However, restrictions in the permit considering data handling and storing and confidentiality requirements considering operative actions, made it impossible to involve police representatives in this study. The absence of police perspective narrows the results. However, as confidentiality restrictions would in any case impact on police informants' possibilities of commenting operative actions, which is remarkable in form of operative workload during the event, the absence of police can be, in this particular case, considered as a minor limitation.

5. Conclusions

In the present study, the multi-sector expert board found consensus in the majority of claims regarding different aspects of preparedness for mass gatherings. Consensus gives stronger background for development of preparedness for mass gatherings and improves possibilities to harmonize practices in this area. This study provides completely new points of views and important details that can be utilized as best practices regarding preparedness for mass gatherings. According to our results, authorities need to prepare for mass gatherings with additional resources, but the focus of their preparedness should be outside of event area, whereas the main responsibility of preparedness inside the venue should lie with the event organizer. However, the expert board agreed that a special situation room should be established in mass gatherings, in which all the essential stakeholders are present. In planning of resources past years data and experiences should be utilized, and authorities' response delays in austere environments should be taken into account in organizer's self-preparedness. Regarding on-site medical care services, the expert board agreed that quality should be favored over quantity, which means that adequate professional-based on-site medical service should not be replaced by larger amount of volunteer-based lower skilled personnel. In the largest and the most high-risk mass gatherings, on-site medical care services should be provided by health professionals rather than by volunteer-based actors. Treatment of emergency patients should always be authorities' responsibility. The results of this study can be implemented in practice, especially in planning process of mass gathering events involving actors from multiple-sectors. Predicting authorities' workload needs further study in order to enable more precise resource deployment during mass gatherings. Investigating the workload through the number of calls, mission types for different authorities, as well as time and location, is likely to give valuable information for resource planning.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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